

TEST PROCEDURES

Disassembly/Assembly Procedures (continued)

Array Procedures (continued):

1.2 Place the array on its back on a bench. Use your thumb to press down on the array grille just where at the top of the curve. At the same time, use the screwdriver to pry the end of the grille off of the array housing. It should come free of the housing. Repeat this step at the other end of the grille. Lift the grille off the housing.

2. Grille Replacement

2.1 Align the grille so that the Bose® logo is facing the same direction as the arrows on the front of the array housing.

2.2 Press the grille in place. It should latch at each end of the grille to the housing.

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Console Procedures

Equipment required:

Audio signal generator
Digital multimeter
Analog to SPDIF converter
SPDIF to optical converter
AM/FM signal generator
Abex test DVD (TDV-540A)
Video monitor
DC power supply
Video cable
Optical cable

Test Setup

Set up the unit under test as shown in Figure x for the following tests.

1. Button Test

1.1 Turn on the unit under test (UUT) using the ON/OFF button on the console. Observe that the display lights up.

2. Analog Audio Test

2.1 Apply a 1 Vrms, 1 kHz signal to the left and right VIDEO 1 audio analog inputs.

2.2 On the console, select the VIDEO 1 input.

2.3 Measure the output level at the line outputs on the console rear panel. It should be 1 Vrms $\pm$ 10%.

2.4 Repeat steps 2.1 to 2.3 for the VIDEO 2 audio analog inputs.

3. Coaxial Digital Audio Test

3.1 Connect the audio signal generator to the input of the analog to SPDIF converter.

3.2 Connect the output of the SPDIF converter to the VIDEO 1 coaxial digital input.

3.3 Apply a 500 mV, 1 kHz signal to the analog input of the SPDIF converter.

3.4 On the console, select the VIDEO 1 source.

3.5 Measure the output level at the line outputs on the console rear panel. It should be 500 mVrms $\pm$ 10%.

3.6 Repeat steps 3.1 to 3.5 for the video 2 digital coaxial input.

3.7 Repeat steps 3.1 to 3.5 for the AUX digital coaxial input.

4. Optical Digital Audio Test

4.1 Connect the audio signal generator to the input of the analog to SPDIF converter.

4.2 Connect the output of the SPDIF converter to the input of the SPDIF to optical converter.

4.3 Connect the output of the optical converter to the VIDEO 1 optical input.

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4.4 Apply a 250 mV, 1 kHz signal to the analog input of the SPDIF converter.

4.5 On the console, select the VIDEO 1 source.

4.6 Measure the output level at the line outputs on the console rear panel. It should be 250 mVrms $\pm$ 10%.

5. Video Tests

5.1 Connect the video generator to the COMPOSITE VIDEO INPUT only.

5.2 Connect the video monitor to the COMPOSITE VIDEO OUTPUT.

5.3 Set the video generator to display a test pattern.

5.4 On the console, select the VIDEO 1 source.

5.5 Confirm that the test pattern appears on the video monitor.

5.6 Connect the video generator to the S-VIDEO input only.

5.7 Connect the video monitor to the S-VIDEO output.

5.8 Set the video generator to display a test pattern.

5.9 On the console, select the VIDEO 1 source.

5.10 Confirm that the test pattern appears on the video monitor.

6. Internal DVD Video Test

6.1 Load the test DVD into the console.

6.2 Connect the video monitor to the S-VIDEO output of the console.

6.3 On the 3-2-1 system remote control, press the CD/DVD button to start playback of the DVD disc.

6.4 Verify that video appears on the video monitor.

7. DVD Audio Test

7.1 Load the test DVD into the console.

7.2 If necessary, connect the Twiddler™ arrays to the 9-pin D-sub connector.

7.3 On the 3-2-1 system remote control, press the CD/DVD button to start playback of the DVD disc.

7.4 Verify that the audio plays.

8. CD Playability Tests

Test discs required:

ABEX TCD-714R
ABEX TCD-721R
ABEX TCD-725R
ABEX TCD-732R
Philips TS4

8.1 Insert the ABEX TCD-725R test disc into the console CD/DVD tray.

- Play the defect tracking (interruption) track. Verify that the track plays properly. The nominal is a 1.0 mm defect, 0.8 mm limit.
- Play the defect tracking (black dot) track. Verify that the track plays properly. The nominal is a 1.0 mm defect, 0.8 mm limit.
- Play the defect tracking (fingerprint) track. Verify that the track plays properly. The nominal is a 75 μ m defect, 65 μ m limit.

8.2 Insert the ABEX TCD-721R test disc into the console CD/DVD tray. Play the defect tracking (scratch) track. Verify that the disc plays properly. The nominal is a 1.6 mm defect, 1.0 mm limit.

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8.3 Insert the ABEX TCD-714R test disc into the console CD/DVD tray. Play the defect tracking (eccentric disc) track. Verify that the disc plays properly. The nominal is a 280 um defect, 210 um limit.

8.4 Insert the ABEX TCD-732R test disc into the console CD/DVD tray. Play the defect tracking (warped disc) track. Verify that the disc plays properly. The nominal is a 1.0 mm defect, 0.7 mm limit.

8.5 Insert the Philips TS4 test disc into the console CD/DVD tray. Play tracks 1 through 15, verifying that each track cues up within the test limits. Nominal is 2 seconds or less, limit 3 seconds.

9. Laser Current Measurement Procedure

Note: The 3-2-1 system console CD/DVD drive uses a separate laser for each medium, CD or DVD. You will need to perform these tests using a CD disc to measure the CD laser current and a DVD disc to measure the DVD laser current.

9.1 Remove the console top cover using Disassembly/Assembly procedure 1.

9.2 Remove the bottom cover of the CD/DVD mechanism to allow access to the board.

9.3 Connect the DVD drive to the console using the ATAPI and DVD power extender cables. This will allow better access to the test points while playing the DVD or CD disc.

9.4 Insert a CD disc into the mechanism tray. Start the disc playing so that the timer on the display is counting.

9.5 Measure and record the voltage at the point 5V and L5V. Be sure to use the GND pad near the 5V and L5V points. See Figure 2.

9.6 Subtract L5V from 5V (5V-L5V) and record the laser voltage (LmV).

9.7 The measured laser current value should be + 20% of the printed current rating on the pickup head (PU). $PU-.20PU < LC < PU+.20$. See Figure 3.

9.8 Repeat steps 3 to 6 for the DVD laser assembly.

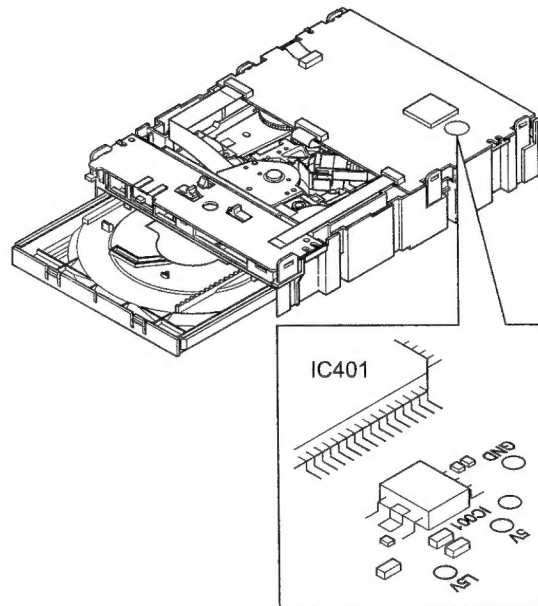


Figure 2. Laser voltage test points

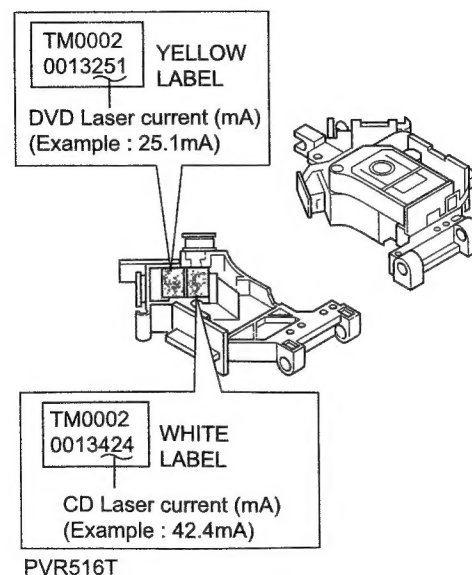


Figure 3. Laser current rating label

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3-2-1 Console Tuner Adjustments/Measurements

The following tests can be performed without the use Of An IBM compatible PC

Set up the device under test (console) as shown in the diagram below.

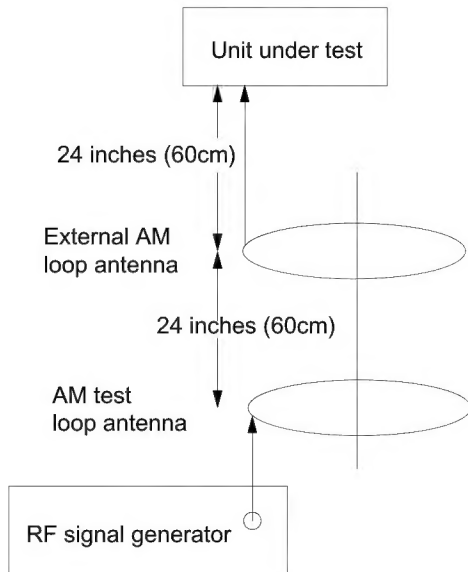


Figure 4. AM Loop Antenna Test Setup

AM Adjustments

For all AM alignments and tests plug the AM antenna, part number 199824-002, into the console and position it at least 2 feet away from the unit. Configure the AM antenna, a standard test loop and RF generator as shown below to create the specified field strength for each test. Set the AM modulation to 30% with a 1kHz signal. Refer to the AM Setup procedure below

10. AM RF Tracking

10.1 Connect an AC meter to the AUX OUT jacks.

10.2 Inject an 1500kHz RF signal at a level of 90 dBuV emf, 30% modulation, 1 kHz modulation frequency.

10.3 Tune the console to 1500 kHz and adjust the red slug (T2004) for maximum audio level at the left or right audio output. Verify that the level is greater than 30 mVrms.

10.4 Change the RF frequency to 600kHz and re-tune the console to 600kHz.

10.5 Adjust the black slug (T2004) for maximum level. Verify that the level is greater than 30 mVrms.

10.6 Repeat steps 10.2 to 10.5 until maximum audio output is obtained without the need for further adjustment.

11. AM Sensitivity

11.1 Inject a 1080kHz RF signal at a level of 74 dBuV emf, 30% modulation, 400 Hz modulation frequency.

11.2 Tune the console to 1080 kHz.

11.3 Connect a dB meter to the tape output jacks and reference it (set to 0dB) to the current audio output.

11.4 Remove the AM modulation and measure the tape output. The reading should be less than -20dB.

FM Adjustments

Note: Unless otherwise noted, set the RF generator for 1 kHz, mono modulation, pilot off and 75 kHz deviation.

Power levels for FM testing are given in dBf at the antenna input to the unit.

Typically a test setup will consist of an RF generator with a 50 ohm output impedance and a 50 ohm to 75 ohm impedance matching element. The two most commonly used impedance matching element are a resistive network which has a 5.7dB insertion loss and a "lossless" transformer which has a 0.5dB insertion loss.

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To find the required setting in dBuV emf from a given dBf value for an RF generator with a 50 ohm output impedance use the conversions given below.

Using a resistive network (5.7dB loss)	Subtract 1.3dB. eg: 65dBf => set generator to 63.7 dBuV emf
Using a "lossless" transformer	Subtract 6.5dB eg: 65dBf => set generator to 59.5 dBuV emf

Note: For generators with RF level resolution of only 1dB round up.

12. FM Distortion Measurement/Adjustment

12.1 Inject a 98.1MHz RF signal at a level of 65dBf into J2000.

12.2 Tune the console to 98.1MHz.

12.3 Measure the distortion plus noise (THD+N) at the tape output. If it is less than or equal to 0.50%, verify that the audio level is greater than 190 mV. If these are not the measurements you have, proceed to step 12.4.

12.4 If the THD+N is greater than 0.55%, or the audio level is less than 190 mV, adjust T2001 for minimum distortion. Verify that the level is greater than 190 mV and the distortion is less than 0.55%.

13. FM Sensitivity

13.1 Inject a 98.1MHz RF signal at a level of 19 dBf into J2000.

13.2 Measure the THD+N at the tape output. It should be less than or equal to 3%.

14. FM Stereo Separation

14.1 Inject a 98.1MHz RF signal set to 1kHz left only modulation with 10% pilot modulation and 75kHz total deviation at a level 65dBf into J2000.

14.2 Reference a dB meter to the left tape output.

14.3 Switch the RF signal modulation to right only channel.

14.4 Measure the left tape output. It should read -25dB or less.

Computer Assisted Tuner Test Procedures

Note: Refer to the computer set up instructions in the appendix for proper connection to an IBM compatible computer.

Refer to Figure 4, AM antenna setup diagram, to achieve the proper field strength for the given RF generator setting.

Some of the commands will automatically set the calibration, requiring only an external RF signal at the input of the tuner. Other commands require the technician to make measurements and adjustments.

Before commencing with the tuner measurements/alignments enter the command LXOF to disable communication between the display microprocessor and the system microprocessor. You should receive an ACK (acknowledge) response on the computer's screen. If not then re-try until successful. To re-enable communication enter LXON.

AM Adjustments

Enter the command TUAM to switch source to AM.

15. AM Alignment

15.1 Inject an 1500 kHz RF signal at a level of 90 dBuV emf.

15.2 Enter the command TUSF15000 into the computer. This will tune the unit to 1500 kHz.

15.3 You should receive the response "ACK>" (acknowledge) on the computer's screen.

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Note: If you receive an error response on the computer screen, enter the TUAM command to ensure the correct mode is selected and re-enter the command in 15.2.

To verify the AM tuning frequency enter the TUGF command to get the presently tuned frequency. The response on the computer screen should be "1500" followed by an "ACK>"

15.4 Adjust the red slug of T2004 for maximum audio output. Verify that the level is greater than 40 mVrms.

15.5 Inject a 600kHz RF signal at a level of 90 dBuV emf.

15.6 Enter the command TUSF06000 into the computer. This will tune the unit to 600 kHz.

15.7 You should receive an ACK response on the computer screen.

15.8 Adjust the black slug of T2004 for maximum audio output. Verify that the level is greater than 40 mVrms.

15.9 Repeat steps 15.1 through 15.8 until the audio level is at a maximum without adjustment.

16. AM Stop Level

16.1 Inject a 1080 kHz RF signal at a level of 78 dBuV emf, 30% modulation at 1 kHz.

16.2 Enter the command TUSF10800 into the computer. This will tune the unit to 1080 kHz.

16.3 You should receive an "ACK>" response on the computer screen.

16.4 Enter the command TUAR. The unit will then sample the AM S-meter level, and store it in the EEPROM as the stop level and return an "ACK>" response.

16.5 Enter the command TURA to see the stored level; the response on the computer should be as follows: XX (where XX is the stored level in hexadecimal form).

The current AM S-meter voltage level = $5 \times (\text{stored level in decimal}) / 256$

FM Tuner Tests

For all FM measurements and adjustments, the RF signal is to be connected from the signal generator to J2000 via a 50 to 75 Ohm impedance matching network. The input levels are to be as read at the input of J2000.

FM Adjustments

Enter the command TUFM to switch source to FM.

17. FM IF Centering Adjustment

17.1 Inject a 98.1MHz, 1 kHz mono modulation, pilot OFF, 75 kHz deviation RF signal (83.0 MHz for Japan) at a level of 50dBf into J2000.

17.2 Enter the command TUSF09810 (TUSF08300 for Japan) into the computer. This will tune the unit to the appropriate frequency.

17.3 You should receive an ACK response on the computer screen.

Note: If you receive an error response on the computer screen, enter the TUFM command to ensure the correct mode is selected and re-enter the command in 17.2.

To verify the FM tuning frequency enter the TUGF command to get the presently tuned frequency. The response on the computer screen should be the "98.1" ("83.0" for Japan)

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17.4 Enter the command TUIF into the computer. The unit will then go through an algorithm that determines the optimum offset for the local oscillator (L.O.) setting to account for filter variances in the IF strip. This offset is then stored in the EEPROM.

Enter the command TUGI to see the stored offset; the response on the computer should be as follows: "TUGI X >" followed by an "ACK>" (where X is the stored offset). The actual frequency offset of the L.O. is this offset multiplied by 25kHz. Valid offsets are -1, 0 or 1

18. FM Distortion Measurement/Adjustment

18.1 Inject a 98.1 MHz, 1 kHz mono modulation, pilot OFF, 75 kHz deviation (83.0 MHz for Japan) RF signal at a level of 65dBf into J2000.

18.2 Enter the command TUSF09810 (TUSF08300 for Japan) into the computer. This will tune the unit to the appropriate frequency.

18.3 Measure the distortion plus noise (THD+N) at the tape output. If it is less than or equal to 0.50%, verify that the audio level is greater than 190 mV. If these are not the measurements you have, proceed to step 18.4.

18.4 If the THD+N is greater than 0.55%, or the audio level is less than 190 mV, adjust T2001 for minimum distortion. Verify that the level is greater than 190 mV and the distortion is less than 0.55%.

19. FM Sensitivity

19.1 Inject a 98.1MHz, 1 kHz mono modulation, pilot OFF, 75 kHz deviation (83.0 MHz for Japan) RF signal at a level of 19 dBf (21dBf for Japan) into J2000.

19.2 Measure the THD+N at the tape output. It should be less than or equal to 3%.

20. FM Stereo Separation

20.1 Inject a 98.1MHz (83.0 MHz for Japan) RF signal set to 1kHz left only modulation with 10% pilot modulation and 75kHz total deviation at a level 65dBf into J2000.

20.2 Enter the command TUSF09810 (TUSF08300 for Japan) into the computer. This will tune the unit to the appropriate frequency.

20.3 Reference a dB meter to the left tape output.

20.4 Switch the RF signal modulation to right only channel.

20.5 Measure the left tape output. It should read -25dB or less.

21. FM Stop Level

21.1 Inject a 98.1MHz, 1 kHz mono modulation, pilot OFF, 75 kHz deviation (83.0MHz for Japan) RF signal at a level of 30 dBf into J2000.

21.2 Enter the command TUSF09810 (TUSF08300 for Japan) into the computer. This will tune the unit to the appropriate frequency.

21.3 You should receive an ACK response on the computer screen.

21.4 Enter the command TUFR. The unit will then sample the AM S-meter level, and store it in the EEPROM as the stop level.

21.5 Enter the command TURF to see the stored level; the response on the computer should be as follows: XX (where XX is the stored level in hexadecimal form).

The current FM S-meter voltage level =
 $5 \times (\text{stored level in decimal}) / 256$.

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22. FM Stereo & Force Mono Threshold

22.1 Inject a 98.1MHz RF (83.0 MHz for Japan) signal set to 1kHz stereo L=R modulation with 10% pilot modulation and 75 kHz total deviation at a level of 42 dBf into J2000.

22.2 Enter the command TUSF09810 (TUSF08300 for Japan) into the computer. This will tune the unit to the appropriate frequency.

22.3 Enter the command TUSR. The unit will then sample the FM S-meter level, and store it in the EEPROM as the stereo level.

Enter the command TURS to see the stored level; the response on the computer should be as follows: XX (where XX is the stored level in hexadecimal form).

22.4 Reduce the RF signal level by 2dB.

22.5 Enter the command TUSM. The unit will then sample the FM S-meter level, and store it in the EEPROM as the force-mono level.

Enter the command TUMS to see the stored level; the response on the computer should be as follows: XX (where XX is the stored level in hexadecimal form).

FM S-meter voltage levels for each of these settings can be calculated as per the stops level.

23. FM Signal to Noise Ratio

23.1 Set the RF signal generator to 98.1 MHz, 1 kHz modulation, pilot off, 75 kHz deviation and at the level that corresponds to 65 dBf into J2000.

23.2 Measure the output level at the left or right audio output. Reference a dB meter to this level.

23.3 Turn off the RF modulation and verify that the level drops by > 70 dB.

Bass Module Procedures

Equipment required:

- Audio signal generator
- dB Meter
- Distortion meter
- Digital multimeter
- 2 Ohm, 50 Watt load resistor
- 60 Ohm, 10 Watt load resistor
- Bass module test cable (see instructions in the appendix)

Test Setup

Refer to Figure x for the following tests.

1. Unpowered Transformer Impedance Test

1.1 On the bass module, set the AC mains switch to the ON position (if applicable). For the International variation, set the voltage select switch to 120V.

1.2 Using a DMM, measure the DC resistance of the transformer primary through the AC connector J1. For the international version, first measure with the voltage select switch set to 115V, then move the switch to 230V and measure again. Verify that the readings are in accordance with the following table.

US/Canada	3.7 Ohms +/- 15%
Europe	14.0 Ohms +/- 15%
Japan	2.8 Ohms +/- 15%
International	3.7 Ohms +/- 15% (115V) 14.0 Ohms +/- 15% (230V)

2. Woofer DC Resistance Test

2.1 Remove the bass module rear enclosure using bass module disassembly/assembly procedure 1.

2.2 Remove the woofer harness from J7 on the bass module PCB. Measure the DC resistance of the woofer voice coil by measuring across the two pins of the woofer harness. It should be 1.55 Ohms $\pm$ 15%.

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3. Power Up Test

3.1 Apply a short across BASS-EQ (J6 pin 6) and AGND (J6 pin 5). Apply 0 V to MUTE (J6 pin 13).

3.2 Apply AC mains voltage to the bass module.

3.3 Measure the transformer quiescent primary current. It should be < 250 mArms.

3.4 Measure the V supply voltage at J6 pins 7, 8, 14 and 15. It should be $+16.5 \pm 1.0$ VDC. Remove the short applied in step 3.1.

3.5 Measure the J7 speaker output DC potential on each pin of the connector relative to PGND at J6 pin 2 or 3. It should be $+ 8.2 \pm 1.0$ Vdc.

4. Gain, Distortion and Mute Tests

4.1 Connect a 2 Ohm, 50 Watt load resistor to the bass channel output to J7 on the bass module PCB.

4.2 Apply a +5 Vdc level to MUTE at J6 pin 13. This DC level will unmute the bass module amplifier.

4.3 Apply a 100 mV, 100 Hz signal between BASS-EQ (J6 pin 6) and AGND (J6 pin 5).

4.4 Reference a dB meter to the input level.

4.5 Measure the output gain level at J7. It should be $+26.0$ dB ± 2.0 dB.

4.6 Measure the distortion level at J7. It should be $< 0.1\%$.

4.7 Apply a 0 Vdc level to MUTE at J6 pin 13. This DC level will mute the bass module amplifier.

4.8 Measure the mute attenuation level at J7 relative to the input level. It should be > 40 dB.

5. Clipping Detect Test

5.1 Remove the bass module rear enclosure using bass module disassembly/assembly procedure 1.

5.2 Unplug the woofer harness connector at J7 on the bass module PCB. Connect a 60 Ohm, 10 Watt load resistor to J7 on the bass module PCB.

5.3 Apply a +5 VDC level to the bass module MUTE input at J6 pin 13. This DC level will unmute the bass module amplifier.

5.4 Apply a 1.0 Vrms, 100 Hz signal between BASS-EQ (J6 pin 6) and AGND (J6 pin 5).

5.5 Using a DMM, measure the average voltage of the digital clipping detect signal COMP (J6 pin 12). It should be $+1.7 \pm 1.0$ Vdc.

5.6 Remove the + 5.0 Vdc level applied to MUTE at J6 pin 13.

5.7 Using a DMM, measure the average voltage of the digital clipping detect signal COMP (J6 pin 12). It should be $+5.0 \pm 0.5$ Vdc.

5.8 Re-connect the woofer harness to J7 on the bass module PCB.

6. Air Leak Test

6.1 Apply a 200 mVrms, 45 Hz signal between BASS-EQ (J6 pin 6) and AGND (J6 pin 5).

6.2 Listen for air leaks around all cabinet seams, joints and wire harness thru-holes. Air leaks will be heard as a hissing or sputtering noise. Repair any air leaks. All repairs must be hidden.

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7. Frequency Sweep Test

7.1 Apply a 350 mVrms, 10 Hz signal between BASS-EQ (J6 pin 6) and AGND (J6 pin 5).

7.2 Sweep the input frequency from 10 Hz to 500 Hz. Listen for any extraneous noises such as buzzes, rattles, ticks, port noise or distortion.

Satellite Array Procedures

Notes:

- Refer to Figure x for the following procedures.
- The satellite arrays are non-repairable. The grilles can be replaced using the disassembly/assembly procedures.
- Each satellite array contains two identical drivers that are wired independently. You must test each of them separately unless otherwise specified.

1. DC Resistance Test

1.1 Using a digital multi-meter, measure the DC resistance of each of the array drivers. Each should measure 3.2 Ohms $\pm$ 10%.

2. Phase Test

2.1 Remove the array grille using Array disassembly/assembly procedure 1.

2.2 Observing polarity, apply a +6 Vdc level to one driver on the array input connector.

2.3 Observe the driver under test. When the DC level is applied, the driver should move outward. If it does, the driver is wired correctly. If not, it is wired incorrectly. Repeat steps 2.2 and 2.3 for the other driver in the array.

3. Air Leak Test

3.1 Apply a 180 Hz, 3 Vrms signal to one of the drivers in the satellite array for 5 seconds minimum.

3.2 Listen for air leaks around all enclosure seams, joints and the input connector. Air leaks will be heard as a hissing or sputtering noise. Repair any air leaks. All repairs must be hidden.

3.3 Listen for any rubbing or ticking noise from the driver. Replace any driver that is defective.

Note: There is a normal suspension noise. To distinguish between a rub or tick and suspension noise, displace the cone slightly with your finger. If the rubbing can be made to go away or get worse, then it is a rub or tick. If the noise stays the same, it is suspension noise.

3.4 Repeat steps 3.1 to 3.3 for the other driver in the array.

4. Frequency Sweep Test

4.1 Jumper both of the drivers in a single array together. Both center pins of the array connector are negative (-). The two outer pins are the positive (+) pins.

4.2 Apply a 100 Hz, 3.0 Vrms signal to both of the array drivers.

4.3 Slowly sweep the signal generator from 100 Hz to 2.0 kHz. Listen for any extraneous noises such as buzzes, rattles, ticks, port noise or distortion. Replace any array with an extraneous noise that can be heard at a distance greater than 1 foot (0.3m).